

WE CLAIM:

1. A method of displaying a three-dimensional image comprising:
 - generating three-dimensional image data for a plurality of pixels, the three-dimensional image data comprising (x,y,z) coordinate and color information, wherein z-coordinate information represents image depth information; and
 - storing the three dimensional image data at locations in a frame buffer in accordance with the z-coordinate information.
2. The method of claim 1 wherein storing comprises:
 - reading the z-coordinate information;
 - scaling the z-coordinate information within a range corresponding to a number of display elements upon which the image data is to be displayed; and
 - assigning locations in the frame buffer for the three-dimensional image data based on the scaled z-coordinate information.
3. The method of claim 1 wherein storing comprises:
 - storing image data associated with a first pixel in a first memory location; and
 - storing image data associated with a second pixel in a second memory location;
 - wherein the z-coordinate information associated with the first pixel is substantially similar to the z-coordinate information associated with the second pixel, and the first memory location is in

close logical proximity to the second memory location.

4. The method of claim 1 wherein the storing comprises storing image data having substantially identical z-coordinate information in memory locations of the frame buffer that are logically substantially proximate.

5. The method of claim 1 further comprising displaying an image on a display having addressable (x,y,z) coordinates.

6. The method of claim 5 wherein storing further comprises assigning a location in the frame buffer for the three dimensional image data in accordance with the equation:

$$\text{Addr} = N_{b/p} * (x + N_x * y + N_x * N_y * z_i)$$

wherein Addr is the assigned location in the frame buffer, $N_{b/p}$ is the number of bytes of information stored for each pixel, N_x is the number of pixels in the x direction of a display, N_y is the number of pixels in the y dimension of a display, and Z_i is an integer portion of the scaled z-coordinate value.

7. The method of claim 1 further comprising displaying an image on a display having addressable (r, y' and theta) coordinates.

8. The method of claim 7 wherein storing further comprises assigning a location in the frame buffer for the three dimensional image data in accordance with the equation:

$$\text{Addr} = N_{B/P} * (r * \cosine(\theta) + N_x * y' + N_x * N_y * r * \sin(\theta))$$

wherein Addr is the assigned location in the frame buffer, $N_{B/P}$ is the number of bytes of information stored for each pixel, N_x is the number of pixels in the x direction of a display, N_y is the number of pixels in the y dimension of a display, and Z_1 is an integer portion of the scaled z-coordinate value.

9. The method of claim 1 wherein storing comprises:

providing a first memory at least as large as the frame buffer;

filling the first memory with the three dimensional image data; and

transmitting the contents of the first memory location to the frame buffer in a single operation.

10. The method of claim 1 wherein storing comprises:

providing a first memory smaller than the frame buffer;

filling the first memory with a portion of the three-dimensional image data;

transmitting the contents of the first memory to a second memory;

rasterizing the three dimensional image data; and

transmitting the contents of the second memory location to the frame buffer.

11. The method of claim 1 wherein storing

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comprises:

providing a first memory smaller than the frame buffer;

filling the first memory with the three dimensional image data; and

transmitting the contents of the first memory location to the frame buffer.

12. The method of claim 1 further comprising transmitting the three-dimensional image data to a display in accordance with the z-coordinate information.

13. The method of claim 1 wherein the image data further comprises transparency information and brightness information.

14. The method of claim 13 further comprising adjusting one of the brightness information and color information of a first pixel based on transparency information of a second pixel.

15. The method of claim 14 wherein the z value associated with the first pixel is greater than the z value associated with the second pixel.

16. The method of claim 1 further comprising displaying an image on a three dimensional volumetric display.

17. The method of claim 16 wherein the three dimensional volumetric display comprises multiple planes upon which image data is displayed.

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means for generating three-dimensional image data for a plurality of pixels, the three-dimensional image data comprising (x,y,z) coordinate and color information, wherein z-coordinate information

represents image depth information; and

means for storing the three dimensional image data at locations in a frame buffer in accordance with the z-coordinate information.

25. The system of claim 24 wherein the means for storing comprises:

means for reading the z-coordinate information;

means for scaling the z-coordinate information within a range corresponding to a number of display elements upon which the image data is to be displayed; and

means for assigning locations in the frame buffer for the three-dimensional image data based on the scaled z-coordinate information.

26. The system of claim 24 wherein the means for storing comprises:

means for storing image data associated with a first pixel in a first memory location; and

means for storing image data associated with a second pixel in a second memory location;

wherein the z-coordinate information associated with the first pixel is substantially similar to the z-coordinate information associated with the second pixel, and the first memory location is in close logical proximity to the second memory location.

27. The system of claim 24 wherein the means for storing comprises means for storing image data having substantially identical z-coordinate information in memory locations of the frame buffer that are

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logically substantially proximate.

28. The system of claim 24 further comprising means for displaying an image on a display having addressable (x,y,z) coordinates.

29. The system of claim 28 wherein the means for storing comprises means for assigning a location in the frame buffer for the three dimensional image data in accordance with the equation:

$$\text{Addr} = N_{b/p} * (x + N_x * y + N_x * N_y * z_1)$$

wherein Addr is the assigned location in the frame buffer, $N_{b/p}$ is the number of bytes of information stored for each pixel, N_x is the number of pixels in the x direction of a display, N_y is the number of pixels in the y dimension of a display, and Z_1 is an integer portion of the scaled z-coordinate value.

30. The system of claim 24 further comprising means for displaying an image on a display having addressable (r, y' and theta) coordinates.

31. The system of claim 30 wherein the means for storing comprises means for assigning a location in the frame buffer for the three dimensional image data in accordance with the equation:

$$\text{Addr} = N_{B/P} * (r * \text{cosine}(\text{theta}) + N_x * y' + N_x * N_y * r * \text{sine}(\text{theta}))$$

wherein Addr is the assigned location in the frame buffer, $N_{B/P}$ is the number of bytes of information stored for each pixel, N_x is the number of pixels in the x direction of a display, N_y is the number of pixels in

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the y dimension of a display, and Z_i is an integer portion of the scaled z-coordinate value.

32. The system of claim 24 wherein the means for storing comprises:

- means for providing a first memory at least as large as the frame buffer;
- means for filling the first memory with the three dimensional image data; and
- means for transmitting the contents of the first memory location to the frame buffer in a single operation.

33. The system of claim 24 wherein the means for storing comprises:

- means for providing a first memory smaller than the frame buffer;
- means for filling the first memory with a portion of the three-dimensional image data;
- means for transmitting the contents of the first memory to a second memory;
- means for rasterizing the three dimensional image data; and
- means for transmitting the contents of the second memory location to the frame buffer.

34. The system of claim 24 wherein the means for storing comprises:

- means for providing a first memory smaller than the frame buffer;
- means for filling the first memory with the three dimensional image data; and
- means for transmitting the contents of

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the first memory location to the frame buffer.

35. The system of claim 24 further comprising means for transmitting the three-dimensional image data to a display in accordance with the z-coordinate information.

36. The system of claim 24 wherein the image data further comprises transparency information and brightness information.

37. The system of claim 36 further comprising means for adjusting one of the brightness information and color information of a first pixel based on transparency information of a second pixel.

38. The system of claim 37 wherein the z value associated with the first pixel is greater than the z value associated with the second pixel.

39. The system of claim 24 further comprising means for displaying an image on a three dimensional volumetric display.

40. The system of claim 39 wherein the three dimensional volumetric display comprises multiple planes upon which image data is displayed.

41. The system of claim 39 wherein the three dimensional volumetric display comprises a plurality of self-luminescent optical elements.

42. The system of claim 39 wherein the three

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dimensional volumetric display is a swept-volume display.

43. The system of claim 24 wherein the means for generating comprises means for generating the three-dimensional image data with a personal computer.

44. The system of claim 24 wherein the means for generating comprises means for converting data corresponding to a three-dimensional image into data corresponding to a plurality of two-dimensional cross-sectional images of the three-dimensional image.

45. The system of claim 24 wherein the means for generating comprises means for generating the three-dimensional image data using application program interface calls.

46. The system of claim 24 wherein the means for generating comprises means for generating data indicating a plurality of geometric primitives that define three-dimensional image.

47. A three dimensional display system comprising:

- a frame buffer and
- a microprocessor programmed to:
 - generate three-dimensional image data for a plurality of pixels, the three-dimensional image data comprising (x,y,z) coordinate and color information, wherein z-coordinate information represents image depth information; and
 - store the three dimensional image data

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at locations in a frame buffer in accordance with the z-coordinate information.

48. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to:

read the z-coordinate information;

scale the z-coordinate information

within a range corresponding to a number of display elements upon which the image data is to be displayed; and

assign locations in the frame buffer for the three-dimensional image data based on the scaled z-coordinate information.

49. The three dimensional display system of claim 47 wherein the wherein the microprocessor is further programmed to:

store image data associated with a first pixel in a first memory location; and

store image data associated with a second pixel in a second memory location;

wherein the z-coordinate information associated with the first pixel is substantially similar to the z-coordinate information associated with the second pixel, and the first memory location is in close logical proximity to the second memory location.

50. The three dimensional display system of claim 47 wherein the wherein the microprocessor is further programmed to store image data having substantially identical z-coordinate information in memory locations of the frame buffer that are logically

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substantially proximate.

51. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to display an image on a display having addressable (x,y,z) coordinates.

52. The three dimensional display system of claim 51 wherein the wherein the microprocessor is further programmed to assign a location in the frame buffer for the three dimensional image data in accordance with the equation:

$$\text{Addr} = N_{b/p} * (x + N_x * y + N_x * N_y * z_i)$$

wherein Addr is the assigned location in the frame buffer, $N_{b/p}$ is the number of bytes of information stored for each pixel, N_x is the number of pixels in the x direction of a display, N_y is the number of pixels in the y dimension of a display, and Z_i is an integer portion of the scaled z-coordinate value.

53. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to display an image on a display having addressable (r, y' and theta) coordinates.

54. The three dimensional display system of claim 53 wherein the microprocessor is further programmed to assign a location in the frame buffer for the three dimensional image data in accordance with the equation:

$$\text{Addr} = N_{b/p} * (r * \cosine(\theta) + N_x * y' + N_x * N_y * r * \sin(\theta))$$

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wherein Addr is the assigned location in the frame buffer, $N_{B/P}$ is the number of bytes of information stored for each pixel, N_x is the number of pixels in the x direction of a display, N_y is the number of pixels in the y dimension of a display, and Z_i is an integer portion of the scaled z-coordinate value.

55. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to:

provide a first memory at least as large as the frame buffer;

fill the first memory with the three dimensional image data; and

transmit the contents of the first memory location to the frame buffer in a single operation.

56. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to:

provide a first memory smaller than the frame buffer;

fill the first memory with a portion of the three-dimensional image data;

transmit the contents of the first memory to a second memory;

rasterize the three dimensional image data; and

transmit the contents of the second memory location to the frame buffer.

57. The three dimensional display system of

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claim 47 wherein the microprocessor is further programmed to:

provide a first memory smaller than the frame buffer;

fill the first memory with the three dimensional image data; and

transmit the contents of the first memory location to the frame buffer.

58. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to transmit the three-dimensional image data to a display in accordance with the z-coordinate information.

59. The three dimensional display system of claim 47 wherein the image data further comprises transparency information and brightness information.

60. The three dimensional display system of claim 59 wherein the microprocessor is further programmed to adjust one of the brightness information and color information of a first pixel based on transparency information of a second pixel.

61. The three dimensional display system of claim 60 wherein the z value associated with the first pixel is greater than the z value associated with the second pixel.

62. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to display an image on a three dimensional

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volumetric display.

63. The three dimensional display system of claim 62 wherein the three dimensional volumetric display comprises multiple planes upon which image data is displayed.

64. The three dimensional display system of claim 62 wherein the three dimensional volumetric display comprises a plurality of self-luminescent optical elements.

65. The three dimensional display system of claim 62 wherein the three dimensional volumetric display is a swept-volume display.

66. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to generate the three-dimensional image data with a personal computer.

67. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to convert data corresponding to a three-dimensional image into data corresponding to a plurality of two-dimensional cross-sectional images of the three-dimensional image.

68. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to generate the three-dimensional image data using application program interface calls.

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69. The three dimensional display system of claim 47 wherein the microprocessor is further programmed to generate data indicating a plurality of geometric primitives that define three-dimensional image.

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